a final estimate of the at least one submersible vehicle's position with a range corrector that utilizes the linear Kalman filter position estimate at time (n), $\chi_{n|n}$, a sea borne position marker, and a measured slant range from the at least one submersible vehicle to the sea borne position marker.

REMARKS

Prior to examination, Applicants respectfully submit this Supplemental Preliminary Amendment amending the above referenced Provisional Application converted to a Non-Provisional Application on May 9, 2002. Applicants respectfully submit the substitute specification attached hereto, amending the format of the current specification to conform to US Practice. Due to the extensive deletions and formatting changes, Applicants believe that a substitute specification is the most efficient way to amend the existing specification to conform with US Practice. Applicants also respectfully submit amended claims 1, 7 and 16 for the above referenced application. Support for these amended claims is contained in the existing specification. Favorable action on the merits of the application is respectfully requested.

Kindly charge necessary fees or credit any overpayment to Deposit Account No. 50-0281.

Respectfully submitted,

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May 30, 2002

Marked-up Claims

1. (AMENDED) A system for the accurate determination of the position of an underwater vehicle comprising:

a sea borne position marker having a known position;

at least one underwater vehicle acoustically coupled to the single position marker;

a system observer comprising a state updater for predicting the underwater vehicle's position, [Pp(n)] $\underline{\chi_n}$, based on a past estimate of the underwater vehicle's position, [Pe(n-1)] $\underline{\chi_{n|n-1}}$ and an estimate of the underwater vehicle's velocity over the sea bottom, and a maximum likelihood estimator, to estimate the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle' velocity over the sea bottom, [Pp(n)] $\underline{\chi_n}$ in a single point position match;

an extended Kalman filter that takes state updater's estimate of the underwater vehicle's position, [Pp(n)] $\underline{\chi_n}$, and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n), and computes a linear Kalman filter position estimate at time (n), [KPAT(n)] $\underline{\chi_{n|n}}$; and

a range corrector that utilizes the linear Kalman filter position estimate at time (n), [KPAT(n)] $\underline{\chi_{n|n}}$, a sea borne position marker, and a measured slant range from the at least one submersible vehicle to the sea borne position marker and computes a final estimate of the at least one submersible vehicle's position.

7. (AMENDED) The system of claim 2 wherein said means for predicting the at least one underwater vehicle's position, based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle's velocity over the sea bottom comprises <u>a state velocity updater</u>.

16. (AMENDED) A computer for the analytic determination of the position of at least one underwater vehicle acoustically coupled to a position marker having a known position using bathymetry data, positioning data, the underwater vehicle's velocity over the sea bottom, and a slant range from the position marker comprising:

a computer for computing

(d) a prediction of the underwater vehicle's position, [Pp(n)] $\underline{\chi_n}$, based on a past estimate of the underwater vehicle's position, [Pe(n-1)] $\underline{\chi_{n|n-1}}$ and an estimate of the underwater vehicle's velocity over the sea bottom with a state updater,

(e) an estimate of the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle' velocity over the sea bottom, [Pp(n)] $\underline{\chi_n}$ in a single point position match with a maximum likelihood estimator,

(f) a linear Kalman filter position estimate at time (n), [KPAT(n)] $\underline{\chi_{n|n}}$ using the state updater's estimate of the underwater vehicle's position, [Pp(n)] $\underline{\chi_n}$, and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n) with an extended Kalman filter, and

a final estimate of the at least one submersible vehicle's position with a range corrector that utilizes the linear Kalman filter position estimate at time (n), [KPAT(n)] $\underline{\chi_{n|n}}$, a sea borne position marker, and a measured slant range from the at least one submersible vehicle to the sea borne position marker.